

Santa Claus can use RNP-AR procedures for safe flights

Why?

The answer is simple: Because the innovative ARIOS RNP-AR procedures at Samedan airport (LSZS) and Interlaken hospital (LSHK) have been established, i.e. designed, validated and inspected, all on the basis of current ICAO standards and – where such standards do not exist yet – state-of-the-art procedures and technology have been applied to ensure maximum flight safety. The bridged gaps in the current rules and standards have been reported to the respective rulemaking bodies including proposals for amendment. The procedures and the defined risk mitigations, particularly with the focus on potential NMAC or MAC situations, are still further evaluated by VFR flights in VMC on Rega's AW109SP helicopters.

Why can only Santa Claus use the procedures?

Whereas the divine aviation regulations do neither require RNP-AR certification for Santa's CAT-A multi-reindeer powered flying sleigh by EASA nor a specific earthly approval by FOCA for the RNP-AR procedures, Santa Claus could already make use of the innovative and safe procedures, but not us here on earth yet, bound to a multitude of approvals and certifications.

Continue reading to know where we

are in our project flight path with the innovative ARIOS project, and with regard to these aforementioned necessary final steps.

FFS AW109SP obtained RNP-AR certification

Rega's AW109SP full flight simulator (FFS) received the certification for RNP-AR flight simulations by FOCA. Like the AW109SP helicopter, the AW109SP FFS is now certified for RNP-AR 0.3 for the approach and RNP-AR 1.0 for the missed approach segment. This is an important milestone: Presumably, the Rega AW109SP FFS is the first helicopter FFS having received such RNP-AR certification.

Flight tests successfully accomplished

Together with ARIOS project partner Leonardo Helicopters, an extensive flight test programme of the ARIOS procedures at Interlaken hospital (LSHK) and Samedan airport (LSZS) has been conducted. The goal was to verify the safe flyability of the coded procedures. This has been accomplished by flight tests flown by the automatic flight control system (AFCS) coupled to the coded procedures in a test navigation database. Formally, the flights were conducted as VFR flights in good VMC.

Since a similar system architecture of the electronic flight instrument system (EFIS) – and especially of the flight management system (FMS) – is important, the flight tests were performed on a AW189 with a similar navigation



Fig. 1: ARIOS Flight test team

management system and AFCS as designed for the AW169-FIPS.

The performance required for accuracy, integrity, continuity and availability was re-confirmed. The combination of flight crew procedures, route design, route coding, FMS and the navigation sensors contributed to better results than required and, thus, created an additional safety buffer for these procedures.

While we know Rega's AW109SP helicopters have an impressive total system error (TSE) with a lateral deviation of 0.02 NM or better, also the much bigger AW189 achieved a similar TSE. In 95% of the flight test time, the lateral deviation was 24m only or less. It can be assumed that path definition error (PDE) and navigation system error (NSE) would be similar and there is a minimal increased flight technical error (FTE), caused by the size of the helicopter. Nevertheless, this was not significant and also not relevant.

In normal flight condition, i.e. no failure condition injected, like a total loss of GPS guidance, single ADS failure, and also in abnormal flight conditions, the helicopter system performance, particularly the TSE, is fully acceptable

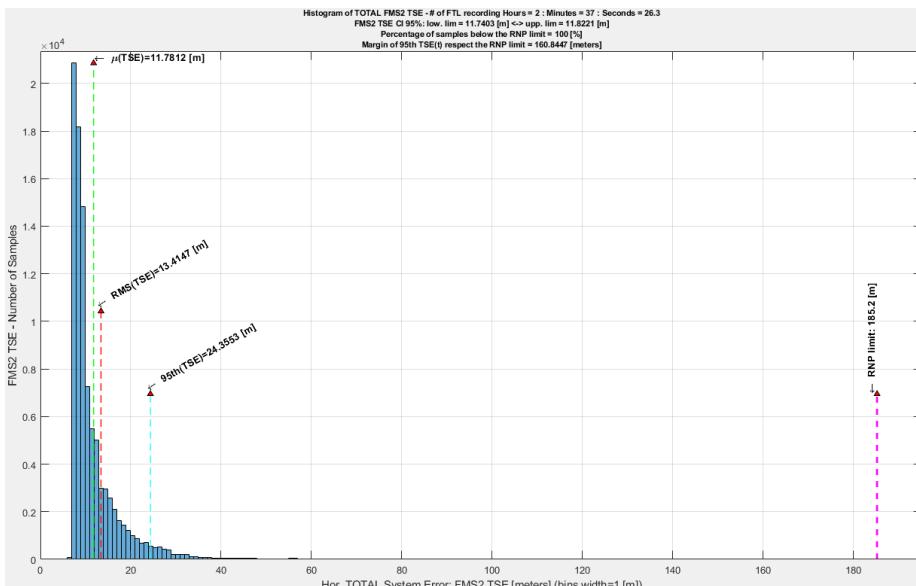


Fig. 3: Histogramme of TSE values confirming compliance with RNP-AR requirements [courtesy of Leonardo]



Fig. 2: Flight instruments incl. HTAWS during the approach at LSZS

for RNP-AR APCH procedures.

In addition to the test parameters for the RNP-AR procedures, Leonardo gathered also data for the RNP-AR certification of the helicopter.

Meteo study completed

Samedan airport (LSZS) is located in a mountain valley at 5,600 ft and is exposed to weather influences from both the south and the north. Although located at an existing airport, the ARI-OS project team deemed it necessary to better understand and calculate realistically the local weather situations at Samedan airport (LSZS) as well as

along the designated RNP-AR routes to and from the airport during all year long and its implications before the background of the overall operational risk and safety assessment. Thus, an analysis of the weather conditions at Samedan regional airport and along the approach routes with detailed insights into the meteorological conditions and with a focus on the parameters that are of particular importance for the intended flights under IFR conditions.

The study has been accomplished by MeteoTest and the following parameters have been analysed:

- Cloud cover and cloud base height
 - Horizontal and vertical visibility
 - Vertical cloud extent
 - Temperatures below 0°C
 - Wind turbulences

Data could be retrieved from the ground measurements including wind direction and speed at ten metres above ground, temperature and dew point at two metres above ground, air pressure, longwave and global radiation and sunshine duration.

The aviation-specific parameters could be found in the METAR reports for LSZS, i.e. wind, temperature, air pressure, cloud cover, cloud base and visibility range as well as significant meteorological phenomena such as thunderstorms.

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Samedan - LSZS
SID RWY 21 - RNP AR
CAT H

SAM ATIS 136.600	SAM ARIS 135.325	ZRH DELTA 119.225			LS811S
INITIAL DEP CRS 206°	ZS464 8100	LS811 8000		ARP ELEV 5602	QNH/WX LSZS

LS811S Proceed via DER21, ZS462, ZS463, ZS464, ZS465, ZS466, LS809, ZS470, ZS471 to LS811 (MAX IAS 120kt). Cross ZS464 at **8100** or above. Cross LS811 at **8000** or above. PDG 7.9% up to 6400.

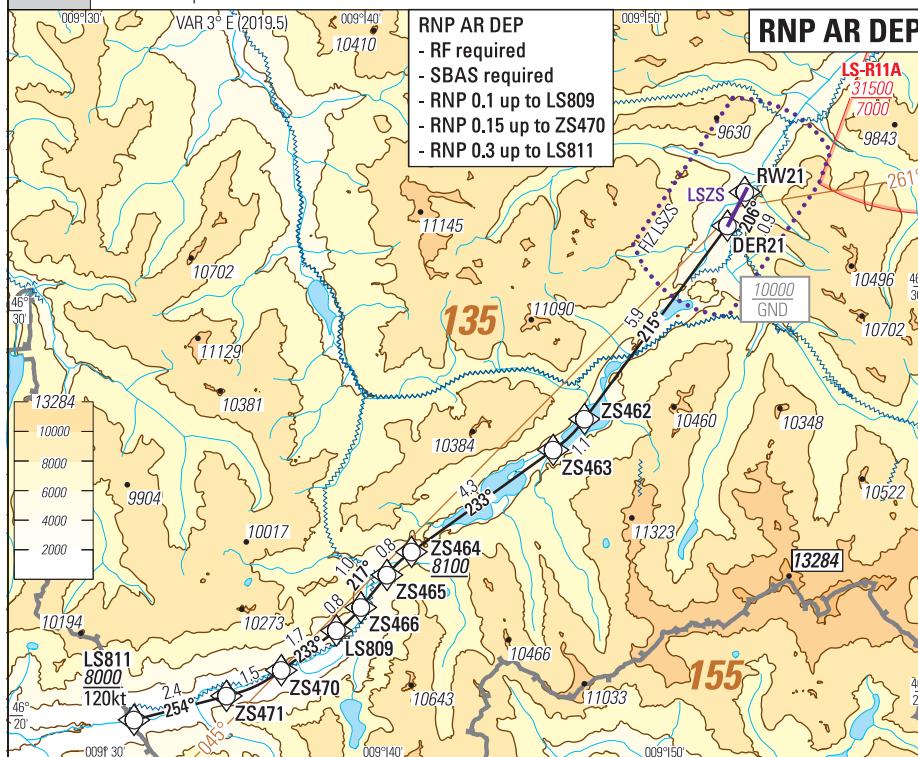


Fig. 4: LSZS SID RWY 03 RNP-AR CAT H via LS811(not for navigation)

Although a METAR contains many important parameters for aviation, it is limited to the airfield and its directly visible surroundings. Consequently, information on parts of the approach and departure routes may be missing, also on the vertical profile such as the vertical extent of clouds or the height of the zero degree boundary. In order to obtain the missing information along the complete approach routes and in the vertical extent, additional model data of the COSMO-1 model of MeteoSwiss has been used in this study.

Altogether, no unexpected weather phenomena were identified. Thus, from a meteorological point of view, the procedures can be flown at Samedan airport (LSZS).

Flight inspection of cross-border route KY258 from Samedan to Lugano

There were no major issues discovered during the flight inspection. The procedures were flown AFCS-coupled within the normal aircraft and airspace limitations without any restrictions. The flight inspection was carried out on a Rega AW109SP equipped with certified measuring equipment from Flight Calibration System GmbH. GNSS interferences have not been detected. Communication with Swiss Radar could also be maintained on the section of the route over Italian territory. GPS and EGNOS parameters were within acceptable limits.

At the same time as the flight inspection, route KY258 was also subjected to a flight validation, whereby the Rega pilot authorised for flight validation assessed the flyability of the procedures. Also positively verified have been human factors with a general workload as satisfactory, RAIM satisfactory, RNP 0.3 always within limits, descent & climb gradients, procedure flown auto-coupled, segment length, turns and bank angles, speed restrictions and deceleration allowance and TAWS.

IFP Reports approved

The following instrument flight procedure (IFP) reports have been approved by Swiss FOCA:

- LSZS RNP Y 03 (AR) LS807
- LSZS RNP Y 03 (AR) LS811
- LSZS RNP Y 21 (AR) LS805
- LSZS SID RWY03 RNP-AR LS801N
- LSZS SID RWY21 RNP-AR LS801J
- LSZS SID RWY21 RNP-AR LS811S
- LSHK RNP 072 (AR)
- LSHK DEP RNP 251 (AR) LS401K

For these departure procedures it was possible to develop and apply new procedure design criteria derived from the ICAO RNP AR Procedure Design Manual (ICAO Doc 9905 advanced draft 3rd Edition [2019]) and the Procedures for Air Navigation Services – Aircraft Operations (ICAO Doc 8168 Vol II 6th Edition incl. AMDT 8), which are documented in the ARIOS Design Criteria for Helicopter RNP AR operations V2.0.

With regard to the solid procedure design as well as the evident and demonstrated performance of the design helicopter AW169 and its FMS, exemptions were granted for RF turns (up to 3.4°/s) and bank angles (up to 24.9° for approaches and up to 17.4° for departures).

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Safety risk assessment

Besides all positive experience with the procedure design, the flight crew and helicopter technical performance, for the final evaluation of potential hazards of RNP-AR flights in IMC, the safety risk assessment and the flight operation safety harassment (FOSA) have to be considered.

Besides the regular FOSA, conducted by Deloitte Torino, we have performed a comprehensive safety risk assessment (SRA) as a standard in Rega's safety assessment process, externally guided and validated by Airnav Consulting in Zurich. First draft versions of these reports have been received, although the formal final and binding documents are delayed at the moment. Amazingly and irritatingly at the same time, large parts of the FOSA have even been used in a master's thesis in aerospace engineering at the polytechnical university of Torino, although the use of the proprietary data has not been authorised by Rega.

Way ahead

The next steps after the design, procedure coding, the successful first flight trials with the AW109SP, AW169 and also with the AW189 is the Rega operational approval by Swiss FOCA. Before this becomes possible, the designated helicopter AW169-FIPS "Ice-Bird" needs a certification for RNP-AR 0.1 for approach and departure, issued by EASA.

Next steps

The results of the FOSA and SRA are to be discussed with the Swiss FOCA in spring 2021, followed by a presentation of the flight test campaign and the FOSA and SRA at EASA in Cologne. After having received confirmation

that both FMS, Genesys (AW109SP) and Leonardo (AW169), include the possibility for a fixed radius transition (FRT) application, Mathias Nyffenegger (Chairman of the ICAO Helicopter Instrument Flight Procedures Working Group) from Skyguide has created a FRT test route in Switzerland.

The route KY258 (RNP 0.3) coding list has already been past to Jeppesen for coding the Rega tailored navigation database (NDB). The FRT coding step will be new for everybody. Jeppesen has already modified the packing tool for FRT with different radius. The coding has been changed already so that any value from 0.1 NM to 99.9 NM can be encoded in 0.1 NM steps.

We plan to fly the route and evaluate the outcome in spring 2021.

In summer 2021, we plan to continue flight tests of the accepted ARIOS RNP-AR procedures on a AW169 helicopter equipped with the designated avionics and software for Rega. Then, in these tests, the normal flight conditions (i.e. no failure injected like a total loss of GPS guidance, single ADS failure etc., as well as abnormal flight conditions will be the focus of the Leonardo flight test team.

Finally, Rega aims at amending the helicopter AOC operation scope and include also RNP-AR in the OPS specification by the Swiss FOCA. To achieve this, the RNP-AR documentation will be amended in the OM A, OM B, OM C and OM D according to EASA PBN SPA requirements already in spring 2021.

Together for innovation also in 2021

We look forward to continuing this endeavour together with you for our

patients and also for an innovative and safe future of modern helicopter aviation.

Santa Claus can already use the procedures safely. Unfortunately, we cannot benefit from these flights – at least not for the ARIOS project. But we certainly benefit from the peace, kindness, joy and laughter Santa Claus brings to us on earth and also to you and your loved ones.

Christmas is about spending time with family and friends. It's about creating happy memories that will last a lifetime (like the ARIOS project). Although the COVID pandemic seems sometimes to cast dark shadows only, during this festive season of giving, let us take time to slow down and enjoy the simple things.

May this time still be a wonderful time of the year touching your heart in a special way. Wishing you much happiness and health not just today and not just for Christmas, but throughout a prosperous New Year 2021.

Zurich Airport, 22 December 2020

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